COVIDIEN

User's Manual

Puritan Bennett™

Power Pack

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1 Safety Information

1.1 Overview

This chapter contains safety information requiring users to exercise appropriate caution while using the Puritan Bennett™ Power Pack with a Puritan Bennett™ 500 Series Ventilator.

1.2 Definitions

This manual uses three indicators to highlight critical information.

Warning
Indicates a condition that can endanger the patient or equipment operator.

Caution
Indicates a condition that can damage the equipment.

Note:
Indicates points of particular emphasis for more efficient or convenient operation of the equipment.

Read, understand, and follow these instructions before using the Power Pack. In addition, to use the Power Pack correctly and efficiently and to help prevent incidents, review and adhere to all warnings and cautions contained in the *Clinician's* or *User's Manual* specific to the ventilator in use.

1.3 Warnings

Fire hazard warnings

- **Never expose batteries to direct flame.**

Warnings before using equipment

- **Never use a Power Pack or any components or accessories that appear to be damaged. If any signs of damage are evident, contact your equipment supplier or Covidien.**

Warnings regarding environment of use

- **Do not operate in direct sunlight, near heat sources, outdoors, or near installations where liquid may pose a risk without first providing adequate protection for the device.**
- **To ensure correct and lasting operation of the device, install and operate the equipment in the environmental conditions/ranges recommended in this manual.**
- **Handle the Power Pack with care during and after use, particularly when ambient temperatures are high. Some Power Pack surfaces may become hot, even if safety specifications are not exceeded.**

- **If the Power Pack has been transported or stored at a temperature that differs more than ±20°C (± 36°F) from the temperature in which it will be operating, allow the Power Pack to stabilise in its operating environment for at least two (2) hours prior to use.**

⚠ Warnings applicable during use of equipment

- **To minimise the risk of damage, you must use the carrying bag to transport the Power Pack.**
- **When the Power Pack is in use, ensure that the ventilator is connected to an alternative power source (such as AC or a fully charged internal battery) before disconnecting the Power Pack battery from the ventilator.**
- **Never immerse the device in any liquid or allow liquid to enter any device opening. Never place a container of liquid on top of the device. Immediately wipe away any liquid on the surface of the device.**
- **Although the Extra Long Life Li-Ion Battery (4.8 AH) meets current safety standards, it exceeds the 100Wh threshold and is therefore considered to be Dangerous Goods (DG) Class 9 – Miscellaneous, when transported in commerce. As such, the Power Pack and/or the associated Lithium-ion battery are subject to strict transport conditions under the Dangerous Goods Regulation for air transport (IATA: International Air Transport Association), International Maritime Dangerous Goods code for sea and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) for Europe. Private individuals who transport the device are excluded from these regulations although for air transport some requirements apply. For air transport, the Extra Long Life Li-Ion Battery is permitted as checked-in or carry-on baggage. Two spare batteries per person may be taken on board as carry-on luggage only, with the prior approval of the airline. This classification and the regulatory requirements may vary depending upon the country and mode of transport. Therefore it is recommended that users verify with the carrier / airline as to which measures to take before the voyage.**

⚠ Warnings regarding electrical power

- **Do not position the Power Pack in a way that makes it difficult to access the AC power cord or power cord connectors. The power cord serves as the means to disconnect the Power Pack from the AC input.**
- **Ensure the Power Pack battery, the Power Pack removable battery and the ventilator's internal battery are fully charged before connecting the ventilator to the Power Pack.**
- **Powering the ventilator using the Power Pack DC cable only does not enable the ventilator's internal battery to recharge.**
- **When recharging the Power Pack batteries, the power supply to which the Power Pack is connected must comply with all applicable standards and provide electrical power corresponding to the AC voltage characteristics stated on the Power Pack label.**
- **To ensure ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use.**
- **To avoid damage to the batteries or electrical components, prevent fluids from entering the device.**
- **Ensure that the AC and DC power cables are in perfect condition and not compressed. The device should not be turned on if the AC or DC power cable is damaged.**
- **Connect the external DC power source by first connecting the power cable to the ventilator and then to the external DC source. Follow the reverse procedure to disconnect the device from the external DC power source.**
- **Connect the AC mains return cable by first connecting the cable to the ventilator and then to the Power Pack AC outlet port. Follow the reverse procedure to disconnect the device from the external DC power source. When connected to the AC mains supply, the Power Pack AC mains return cable is a live mains cable and should be treated as such.**

- **The maximum recommended shelf life of the internal battery is two (2) years. Do not use a battery that has been stored for two years, or more, within or removed from the Power Pack prior to its first use. Periodic recharging is important to help maximise useful life of the battery. Do not store the battery for extended periods, without recharging, as this may reduce the maximum life.**

Warnings regarding hoses and accessories

- **To ensure proper performance of the equipment, use only accessories approved and recommended by Covidien.**

Warnings regarding maintenance

- **Other than replacing the removable battery, do not attempt to open, repair or otherwise service the Power Pack. Doing so might endanger the patient, damage the battery, and/or void the warranty. Only personnel authorised and qualified by Covidien should repair, open, or service the Power Pack.**
- **Regularly clean the Power Pack device and carrying bag according to manufacturer's recommendations.**
- **Use all cleaning solutions and products with caution, using only those solutions listed in this manual. Read and follow the instructions associated with the cleaning solutions used to clean the device.**

Warnings to protect the environment

- **The battery and the Power Pack should be considered as waste electrical and electronic equipment (WEEE). Dispose of battery and Power Pack in accordance with local requirements and regulations.**

1.4 Symbols, Labels and Markings

Table 1-1. Symbol Descriptions

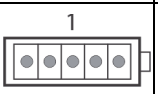
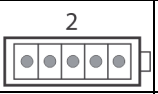
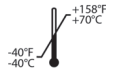
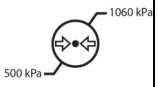
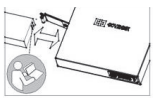
Symbols	Descriptions
	Caution, consult accompanying documents. Read, understand, and follow the *User's Manual* instructions before using the Power Pack.
	DC power indicator on the ventilator.
	Alternating Current indicator.
	Charge indicator push button.
	Internal battery charge indicator.
	Removable battery charge indicator.
	Temperature LED.
	Serial number.
	IP3X: Protection rating against the intrusion of small foreign bodies into the device (without carrying bag). IPX2: Protection rating against water dripping or falling vertically when enclosure is tilted up to 15 degrees on either side of the vertical, as well as an environment featuring water vapour, condensation, or light rain (with device inside carrying bag).
	Canadian Standards Association (CSA). Signifies compliance with all applicable standards for the Canadian market.
	Manufacturer.
	Year of manufacture.
	WEEE (Waste Electrical and Electronic Equipment) symbol. This product must not be disposed of with household waste. Observe local ordinances for proper disposal.
	Air dry after cleaning.
	Machine wash up to 40ºC (104ºF) temperature water.
	Do not bleach.
	Do not iron.
	Do not dry clean.

Table 1-1. Symbol Descriptions (Continued)

Symbols	Descriptions
	Temperature limitation.
	Humidity limitation.
	Atmospheric pressure limitation.
	Electromagnetic symbol.
CE 0123	CE - Conformity European Signifies compliance with the medical device directive 2007/47/EC.
Rx ONLY	For prescription use only.
	Label advising user to read the *User's Manual* for information on how to insert the battery. See 3-2, Battery Placement, on page 12.
	Insulation Class II Equipment (IEC 60417-5172).
	Keep dry.
	Operator must consult instructions for use.

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2 General Introduction

2.1 Overview

This chapter contains general information about the Puritan Bennett™ Power Pack.

2.2 Indications for Use

Intended Use

The Puritan Bennett™ Power Pack provides an external battery which connects to the Puritan Bennett™ 500 Series Ventilators. It is an external DC power source.

Target Operators

- Respiratory therapists
- Doctors
- Nurses
- Homecare providers
- Patient and patient's families

Target Environments

The Power Pack is suitable for use in institutional, home, and portable settings.

2.3 List of Components

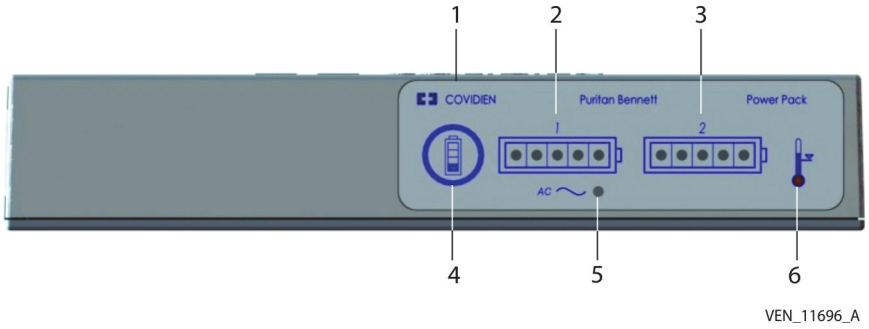
Table 2-1. Typical Power Pack Carton Packing List

Quantity	Item
1	Power Pack enclosure, including internal charger and battery
1	DC connection cable (25cm)
1	Carrying bag (blue or pink based on customer request)
1	Puritan Bennett™ Power Pack *User's Manual*
1	AC mains cable
1	AC mains return cable

2.4 Power Pack Enclosure Views

Front Panel

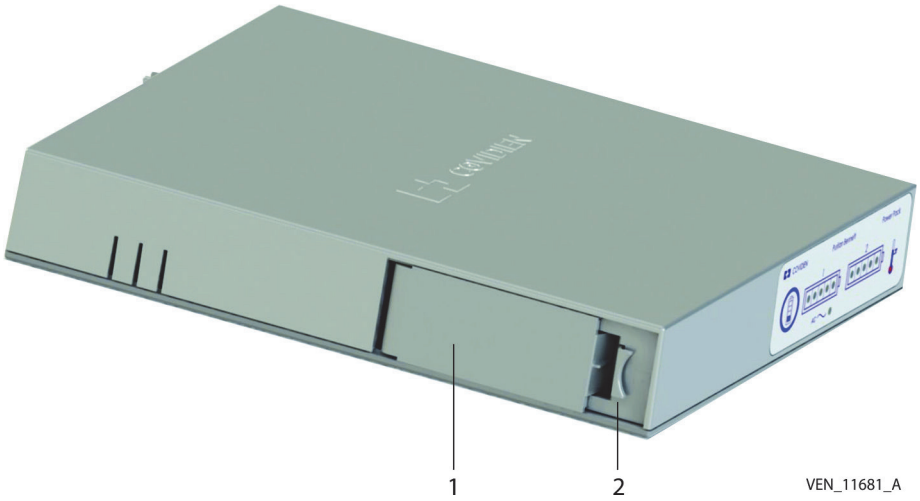
Figure 2-1. Front Panel



1 Keyboard
2 Battery charge indicator LED, Internal Battery
3 Battery charge indicator LED, Removable Battery
4 Charge indicator push button
5 AC power indicator
6 Temperature LED

Side Panel

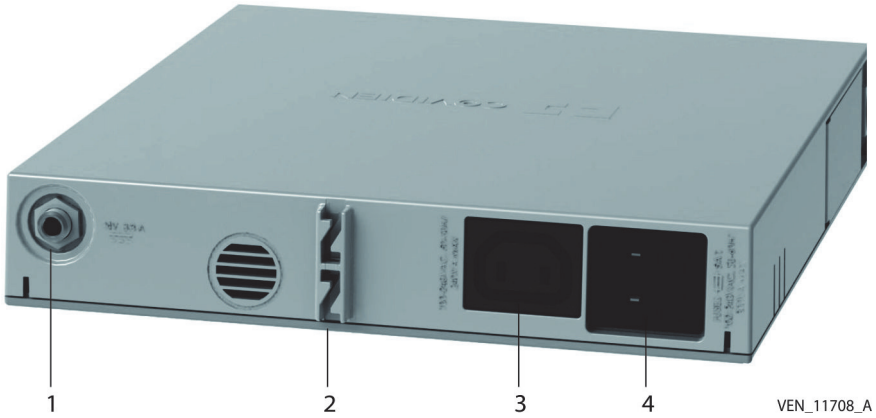
Figure 2-2. Side Panel



1 Removable battery slot door
2 Battery door latch

Rear Panel

Figure 2-3. Rear Panel



1 DC connector
2 AC mains cable retention
3 AC mains output connector
4 AC mains input connector

Front View

Figure 2-4. Ventilator Dual Bag and Power Pack Carrying Bag

1 Power Pack carrying bag
2 Ventilator dual bag

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3 Installation

3.1 Overview

This chapter contains information for installing the Puritan Bennett™ Power Pack and connecting it to a Puritan Bennett™ 500 Series Ventilator.

3.2 Installation Instructions

Warning

Ensure the Power Pack battery, the Power Pack removable battery and the ventilator's internal battery are fully charged before powering the ventilator from the Power Pack.

Powering the ventilator using the Power Pack DC connection cable only does not enable the ventilator's internal battery to recharge.

If the Power Pack system is used without its carrying bag, set it down on a flat stable surface so that the shock absorber feet are all in contact with the surface. If not, it can also operate inside its carrying bag in any other position. Check that the surroundings do not hinder the different connections needed to run the apparatus, causing falls or jamming the cables connected to it.

3.3 Installation of Power Pack into Carrying Bag

1. Open the front panel of the carrying bag.
2. Slip the Power Pack into the carrying bag.
3. Secure the Velcro® strips to secure the Power Pack.
4. Check that the Power Pack is correctly inserted into the carrying bag and that the keyboard is clearly visible.

Figure 3-1. Power Pack Installation

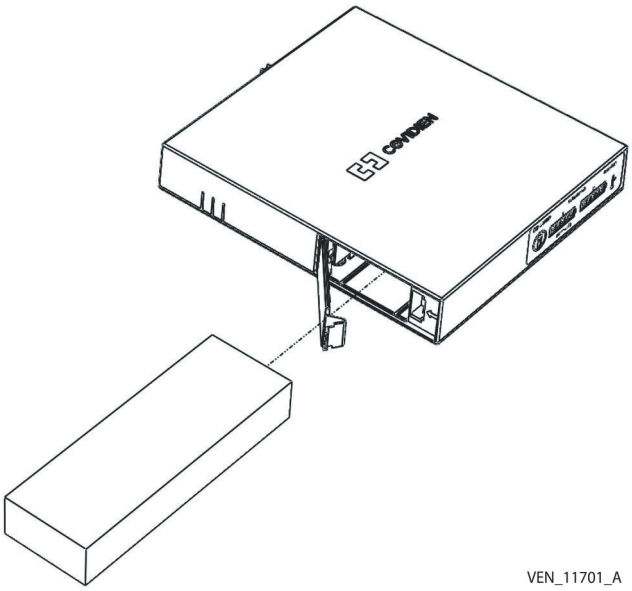
VEN_11679_A

3.4 Removable Battery Installation in Power Pack

To install the removable battery in the Power Pack enclosure:

1. Place the removable battery and Power Pack on a level, dry surface to avoid risk of damage.
2. Open the door latch of the removable battery compartment.
3. Position the battery to match the orientation shown on the label inside the door latch.
4. Slide the battery into the removable battery compartment and push gently into place.
5. Close the door latch of the battery compartment.
6. Click the latch to the right to ensure it is securely fastened.
7. Check that the Power Pack is correctly inserted into the carrying bag and that the keyboard is clearly visible.
8. Charge the removable battery. See "Power Pack Battery Charge Procedure" on page 13.

Figure 3-2. Battery Placement



3.5 Power Pack Battery Charge Procedure

To charge the Power Pack batteries:

1. Connect the AC mains cable to the AC mains input connector.

Figure 3-3. AC Mains Connection

2. Connect the other end of the AC power cable to a mains power outlet.

AC ~ ○ When mains power is connected, the green AC indicator light on the front panel lights up. The display automatically becomes active and informs the user of the battery charge.

When the battery is charging, the battery level indicator LEDs light up in sequence. The first green LED lights up, then the second, then the third, then the fourth, then the fifth. Then they all turn off and the sequence restarts until charging is complete.

For any other installed battery the battery level indicator shows the battery charge level. Once charging is complete, the battery level indicator shows the charge level for each installed battery.

Note:

When the Power Pack system is connected to AC mains, the 24V DC power output is not available to power the ventilator.

The ventilator can be connected to the AC mains supply by means of the AC Mains return cable. This cable can be used to provide power to the ventilator and to charge its internal battery while the batteries of the Power Pack system are being charged.

3.6 Power Pack to Ventilator Connections

Warning

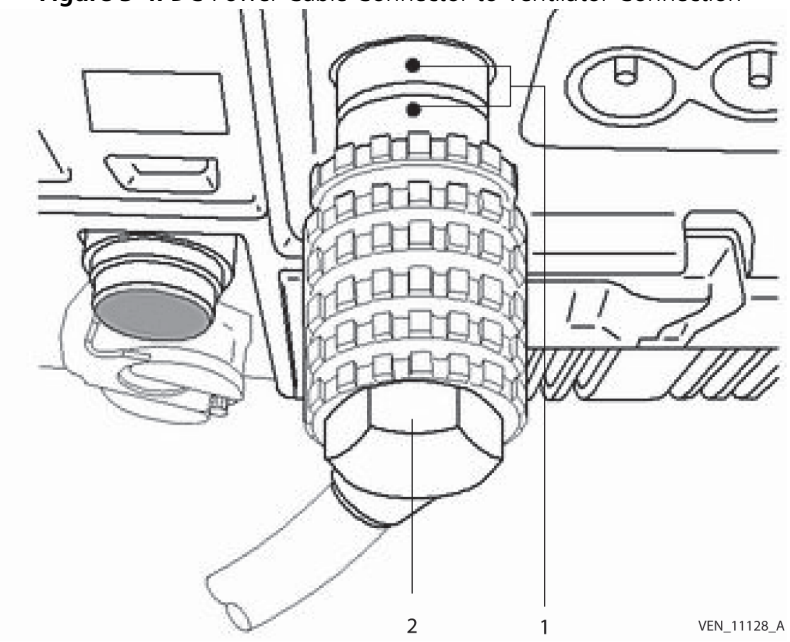
Ensure the Power Pack battery, the Power Pack removable battery and the ventilator's internal battery are fully charged before connecting the ventilator to the Power Pack.

If the Power Pack has been transported or stored at a temperature that differs more than ±20°C (± 36°F) from the temperature in which it will be operating, allow the Power Pack to stabilise in its operating environment for at least two (2) hours prior to use.

To connect the Power Pack DC output to the ventilator DC input:

1. Line up the red marker dot on the ventilator's DC power connector with the marker on the ventilator connector on the Power Pack cable.

Figure 3-4. DC Power Cable Connector to Ventilator Connection

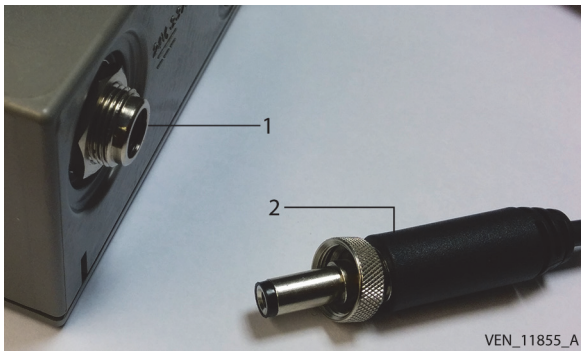


1 Red dots, aligned
2 DC power cable

2. Push the DC power cable onto the ventilator's DC power connector until an audible click occurs. The click indicates the connectors are locked together.
3. Connect the round pin plug on the DC cable to the Power Pack DC output socket.

4. Screw the locking ring onto the socket to lock the plug in place.

Figure 3-5. DC Power Cable Connection



1 DC output socket
2 Pin plug

With the proper connection of all cables, the DC POWER ⎓ indicator on the top left corner of the ventilator illuminates.

To disconnect the DC power cable from the Power Pack and the ventilator:

1. Unscrew the locking ring from the DC Plug connected to the Power Pack
2. Unplug the cable from the Power Pack.
3. A "DC POWER DISCONNECTION" alarm signals an automatic switch to the ventilator internal battery.
4. Grasp the DC power cable on the ventilator.
5. Slide the locking ring back.
6. Pull the plug away from the Power Pack's rear panel to disengage it.
7. Place the cable in a safe location for future use.

To connect the Power Pack AC output to the ventilator AC Input:

1. Connect the smaller figure-8 style plug to the ventilator AC input socket.
2. Fit the cable retention clip on the cable into the slot on the back of the ventilator.
3. Connect the larger AC plug to the AC outlet on the Power Pack.
4. Fit the cable retention clip on the cable into the slot on the side of the Power Pack.

To disconnect the Power Pack AC output from the ventilator AC Input:

1. Disconnect the larger AC plug from the AC outlet on the Power Pack.
2. Detach the cable retention clip from the slot on the side of the Power Pack.
3. Disconnect the smaller figure-8 style plug from the ventilator AC input socket.
4. Detach the cable retention clip from the slot on the back of the ventilator.

3.7 Connecting the Dual Bag to the Carrying Bag

To connect the ventilator dual bag to the Power Pack carrying bag:

1. Slip the Puritan Bennett™ 500 Series ventilator into the ventilator dual bag.
2. Secure the Velcro® strips to secure the ventilator.
3. Connect the clips on each side of the dual bag to the top receiving clips of the Power Pack bag to secure both bags together. See Figure 2-4 on page 9.
4. Follow the procedure for connecting DC power to the Power Pack and the ventilator.

Note:

Users may choose to use the dual bag with or without the additional wheelchair strap.

3.8 Installation on a Wheelchair Using the Dual Bag

To install the dual bag on a wheelchair:

1. Locate the lower clips extending from the bottom sides of the Power Pack portion of the dual bag.
2. Pass the wheelchair strap across the face of the wheelchair back.
3. Connect both wheelchair strap clips to the corresponding receiving clips on the dual bag.
4. Test connections to ensure the dual bag is securely fastened to the wheelchair back.

Note:

The remaining steps are optional. Not all wheelchairs provide a backbrace bar behind the wheelchair back.

5. Locate the rounded D-ring connector directly below the ventilator control panel on the dual bag.
6. Clip the appropriate strap to the D-ring on both sides.
7. Tighten the strap onto the backbrace behind the wheelchair back.
8. Test connections to ensure the dual bag is securely fastened to the backbrace.

Figure 3-6. Installing the Power Pack onto a Wheelchair

3.9 Uninstalling Removable Battery

Warning

When the Power Pack is in use, ensure that the ventilator is connected to an alternative power source (such as AC or a fully charged internal battery) before disconnecting the Power Pack battery from the ventilator.

To uninstall the removable battery:

Caution

Ensure that an alternative power source is provided before disconnecting the removable battery.

1. Push on the battery door latch on the battery door on the side of the Power Pack to disengage it. See Figure 2-2 on page 8.
2. Open the battery door.
3. Slide out the battery.

3.10 Removable Battery Replacement

To replace the removable battery with a charged spare battery (whether or not the Power Pack is in use at the time):

1. See Figure 3-2 on page 12.
2. Place the spare battery in a convenient, level, dry location for ready installation.
3. Open the door latch of the removable battery compartment.
4. Pull with a steady pressure until the battery disengages from the connect points in the Power Pack.
5. Remove the depleted battery and set it aside in an alternate level, dry location.
6. Position the removable battery to match the orientation shown on the label inside the door latch.
7. Slide the removable battery into the battery compartment and push gently into place.
8. Close the door latch of the removable battery compartment.
9. Click the latch to the right to ensure it is securely fastened.
10. Ensure the depleted battery is recharged before re-using.

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4 Operation

Warning

To ensure ventilation continues uninterrupted, ensure alternative power sources are available (AC power source, extra batteries, or an auxiliary DC car adapter). Be prepared for the possibility of power failure by having an alternative means of ventilation ready for use.

4.1 Overview

This chapter contains information for operating the Puritan Bennett™ Power Pack.

4.2 Battery Indicators

Any time the ventilator is not connected to a power main source, but is connected to the Power Pack, the ventilator runs on the Power Pack battery.

4.3 Charging Battery Auto Test

Each time the AC mains power is applied to the Power Pack, there is a start up auto-test. The ten battery charge indicator LEDs on the Power Pack light up green and the red LED flashes red for 500ms. The mains AC indicator LED also lights up to indicate that AC mains power is present.

4.4 Charging the Power Pack Batteries

The AC mains indicator LED lights up to indicate that mains power is turned on. When the battery pack is charging, the battery charge indicator LEDs light up in sequence to indicate that either the internal or removable battery is being charged.

The first green LED lights up, then the second, then the third, then the fourth, then the fifth. Then they all turn off and the sequence restarts.

If two batteries are installed this charge sequence will be displayed only for the battery which is currently being charged. The battery charge level will be displayed for the other battery.

The batteries are charged in sequence with the internal battery being charged first before switching automatically to charging the removable battery (if present).

Note:

When the Power Pack system is connected to the AC mains, the DC Output power will not be available to power the ventilator.

The ventilator can be connected by means of the AC mains return cable. This cable can be used to provide AC mains power supply to the ventilator and to charge its internal battery while the batteries of the Power Pack system are being charged.

4.5 When the Power Pack Battery Is Powering the Ventilator

The battery charge indicator, a series of five green LEDs for each battery, displays the remaining battery power. If all five LEDs are lit, the battery is fully charged; the LEDs switch off one by one as the battery becomes depleted.

A battery charge indicator is present for both the internal battery and the removable battery to indicate the battery charge level for each of the installed batteries.

The batteries are discharged in sequence with the removable battery being discharged first (if present) before switching automatically to discharging the internal battery.

4.6 Battery Charge Indicator

The operator can check the level of charge of the battery when it is not attached to the ventilator by pressing on the charge indicator push button. Each time the charge indicator button is pressed an auto test sequence will be performed as described in section 4.3, "Charging Battery Auto Test".

Following this sequence, the battery charge indicator LEDs will light up for five seconds to indicate the remaining charge in the installed batteries. See Figure 2-1 on page 8. When the Power Pack is used to power the ventilator, the battery charge indicator LEDs will light up to Indicate the remaining charge level for each of the installed batteries.

4.7 Low Battery Indicator

When the battery is running low, the farthest-left LED on the battery charge indicator turns yellow/orange.

4.8 Depleted Battery Indicator

When the Power Pack battery is fully depleted, the ventilator automatically switches to the ventilator's internal battery and an audible and visible DC POWER DISCONNECTION alarm sounds on the ventilator. Refer to the *Clinician's* or *User's Manual*.

4.9 Temperature Indicator

If the Power Pack is operating outside recommended environmental conditions, the temperature LED lights up, the ventilator automatically switches to the ventilator's internal battery and an audible and visible DC POWER DISCONNECTION alarm sounds on the ventilator. Refer to the ventilator *Clinician's* or *User's Manual*.

5 Maintenance

5.1 Overview

This chapter describes required steps to maintain and properly clean the Puritan Bennett™ Power Pack. Follow local governing ordinance and recycling instructions regarding the disposal or recycling of the Power Pack and its accessories.

5.2 Cleaning

Warning

Use all cleaning solutions and products with caution. Read and follow the instructions associated with the cleaning solutions you use to clean your Power Pack. Use only those solutions recommended in this manual.

Never immerse the device in any liquid or allow liquid to enter any device opening. Never place a container of liquid on top of the device. Immediately wipe away any liquid on the surface of the device.

To avoid damage to the batteries or electrical components, prevent fluids from entering the device.

Approved Cleaning Solutions for Exterior Surface:

- Mild dishwashing detergent
- 70% isopropyl alcohol (rubbing alcohol)
- 10% chlorine bleach (90% tap water)
- Glutaraldehyde
- Hospital disinfectant cleaners
- Hydrogen peroxide
- 15% ammonia (85% tap water)
- Ammonia-based household cleaners
- Household cleaners

Clean all external panels and surfaces before and after each patient use and as often as necessary to keep the battery pack clean. Clean the battery pack periodically, whenever it is soiled or dirty, before any maintenance operation, and before storing.

Note:

To clean the ventilator, follow the cleaning instructions in the ventilator *Clinician's* or *User's Manual*.

To surface clean Power Pack exterior surfaces:

1. Dip a clean, soft cloth into a mixture of mild soap and water, or other approved cleaning solution from the list of approved cleaning solutions.
2. Squeeze the cloth thoroughly to remove excess liquid.

3. Lightly wipe the external Power Pack carrying bag, taking care not to allow excess moisture to enter any surface openings.
4. Lightly wipe the Power Pack, taking care not to allow excess moisture to enter any openings.

Note:

If the instructions associated with the cleaning fluid being used require that the solution be left on the surface for a period of time, then do not wipe off the solution until that amount of time has passed.

5. Dry the Power Pack enclosure surface with a clean, soft, lint-free cloth.

5.3 Preventive Maintenance

Perform the following safety checks:

- Prior to using the Power Pack with a patient
- Monthly while the Power Pack is in use
- Following maintenance

Table 5-1. Operational Verification Checklist

1	Verify the proper appearance and cleanliness of the Power Pack.
2	Verify all of the labels on the Power Pack are clear and legible. If labels are damaged or illegible, contact Covidien Technical services or your local Covidien representative. See "Technical Support Contacts" on page iii.
3	Ensure the DC connector power cable does not exhibit any signs of damage, such as kinks, breaks, or damaged insulation.
4	Replace the batteries every 24 months. See "Internal Battery Replacement" on page 33.
5	Ensure the AC cable does not exhibit any signs of damage, such as kinks, breaks, or damaged insulation.

5.4 Fuse Removal and Replacement

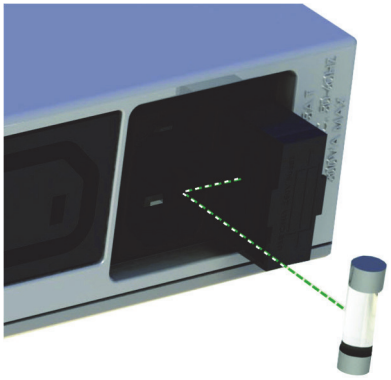
Warning

- **Before attempting to replace the AC mains fuse, disconnect the power cord to avoid possible injury.**

To remove and replace the fuse

1. Using fingers or a suitable tool, pull out the fuse drawer from the AC mains input connector to expose the fuse.

Figure 5-1. Fuse Replacement



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2. Remove the fuse using a small flat blade screwdriver.
3. Replace with new 5 Amp, 250 Volt fuse and push the fuse cartridge back until it snaps into the closed position.

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6 Troubleshooting

6.1 Overview

This chapter provides guidance on how to troubleshoot and correct common problems that might occur with the Power Pack.

Table 6-1. Troubleshooting Guidelines

Symptom	Possible Reason(s)	Corrective Action(s)
AC mains LED does not light, batteries will not charge	AC mains not connected	Check connection to AC mains Verify AC mains connector fully inserted
	AC mains fuse has blown	Replace AC mains external fuse
	Internal charger error	Contact Covidien Technical Services (See "Technical Support Contacts" on page iii)
Internal battery (Battery 1) charge indicator LEDs do not light	Internal battery has been damaged	Contact Covidien Technical Services
	Internal battery is completely discharged	Connect to AC mains and run a full 12-hour charge cycle
Removable battery (Battery 2) charge indicator LEDs do not light	Removable battery is not present	Verify presence of removable battery
	Removable battery compartment door is open	Check that removable battery compartment door is securely closed
	Removable battery is completely discharged	Connect to AC Mains and run a full 12-hour charge cycle
Ventilator does not display AC mains power indicator when connected to Power Pack using AC mains return cable	AC mains not connected to Power Pack	Check connection to AC mains Check AC mains connector fully inserted
	AC mains return cable not connected between Power Pack and ventilator	Check connection of AC mains return cable between Power Pack and ventilator
Ventilator does not display external DC power indicator when connected to Power Pack using DC cable	DC cable not connected correctly	Check connection of DC cable between Power Pack and ventilator
	Power Pack batteries are not charged	Check charge level of Power Pack battery using charge Indicator button
Temperature indicator red LED lights up	Power Pack temperature out of range	Bring Power Pack to specified ambient temperature range
	Internal battery damage and/or error	Contact Covidien Technical Services

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7 Parts and Accessories

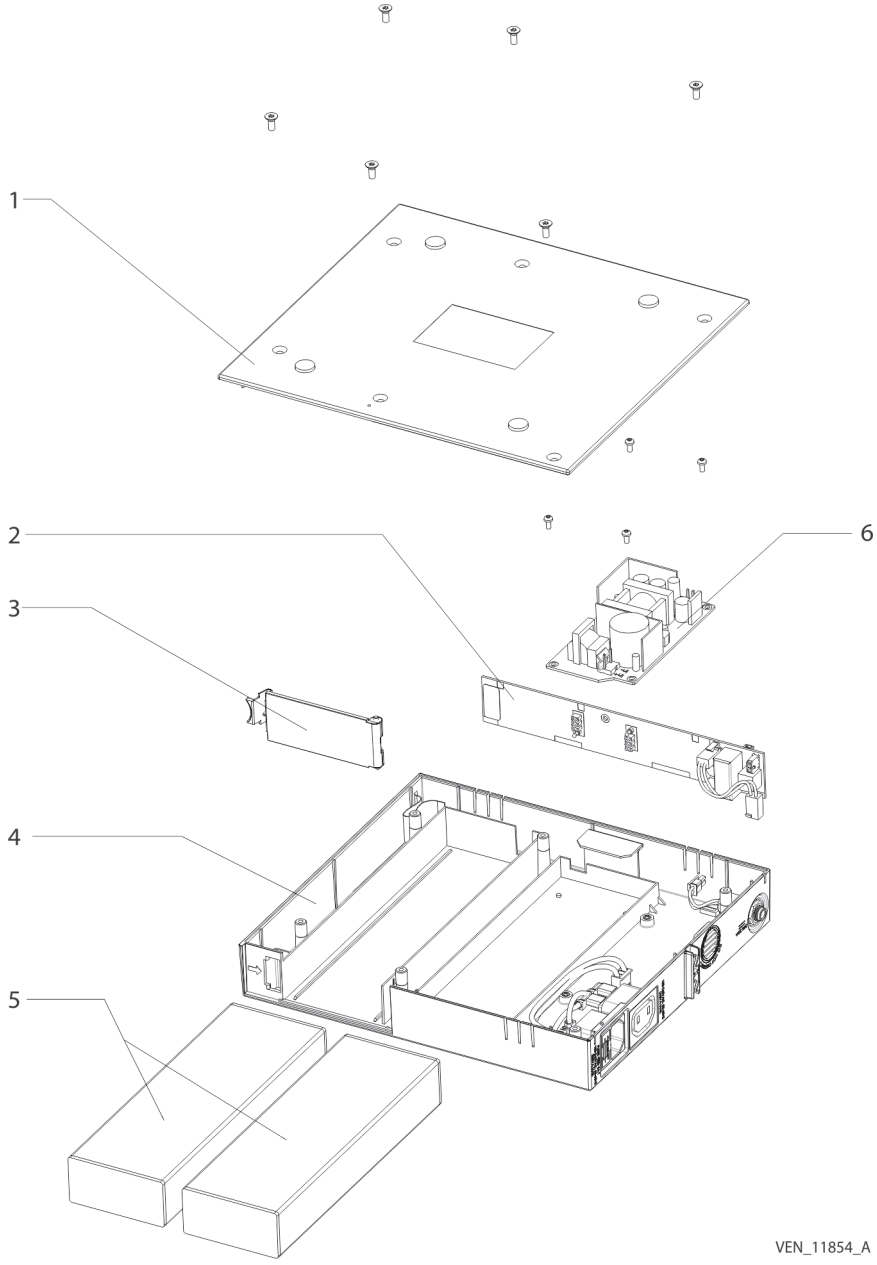
7.1 Overview

This chapter describes how to order spare parts and accessories for the Puritan Bennett™ Power Pack.

7.2 Replacement Parts

For more information or to order parts or accessories, contact your equipment supplier or Covidien representative or consult the Covidien website at: http://www.respiratorysolutions.covidien.com.

Figure 7-1. Replacement Parts Exploded View



1 Housing cover
2 Printed circuit board assembly (PCBA)
3 Battery compartment door
4 Housing
5 Batteries
6 AC/DC converter with integrated battery charger

Table 7-1. Consumables and Accessories

Description	Part number
Power Pack	4098100
Power Pack Main Housing Assembly	10131548
DC cable (25 cm)	10109802
DC cable (80 cm)	10127418
Power Pack (Dual Battery) Mains Cord EU	10131165
Power Pack (Dual Battery) Mains Cord UK	10131158
Power Pack (Dual Battery) Mains Cord Japan	10131159
Power Pack (Dual Battery) Mains Cord China	10131163
Power Pack (Dual Battery) Mains Cord SAF/India	10131164
Power Pack (Dual Battery) Mains Cord Australia	10131166
Power Pack (Dual Battery) Mains Cord Canada	10131167
Power Pack (Dual Battery) Mains Cord Brazil	10131168
Power Pack carrying bag (blue)	10122036
Power Pack carrying bag (pink)	10122037
Extra Long Life Li-Ion Battery (4.8 AH)	10087047
AC Mains Return Cable	10131191
Printed Circuit Board Assembly (PCBA)	10131169
AC/DC Converter with Integrated Battery Charger	10116976
Housing Cover	10132667
Housing Door	10132668
PB500 Series battery extraction tab	10100901

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8 Service

8.1 Overview

This chapter contains instructions for servicing the Puritan Bennett™ Power Pack.

8.2 Warnings and ESD Control

This section provides instructions for servicing the Power Pack.

⚠ Warnings regarding qualified service providers and serviceable parts

- **Only qualified service personnel should remove the Power Pack cover.**
- **There are no user-serviceable parts inside.**
- **Users may not modify any components of the system.**

⚠ Warning regarding shock hazard

- **Before attempting to open or disassemble, disconnect the power cord to avoid possible injury.**

⚠ Warning regarding batteries

- **Use only Covidien-approved batteries.**

⚠ Warning regarding electrostatic discharge

- **Observe electrostatic discharge (ESD) precautions prior to opening the unit or handling any internal components.**

⚠ Warning regarding tightening screws

- Observe the required torque for tightening screws. Over-tightening can strip out screw holes, rendering them useless.

Electrostatic Discharge Control

It is important to follow ESD control procedures whenever the Power Pack is serviced. Electrostatic discharge can permanently damage ESD-sensitive microelectronic components or assemblies when they are handled, even when no direct contact is made with the component or assembly. ESD damage may not be immediately detectable; however, ESD damage will show up at a later time. It can manifest as a premature catastrophic failure of a component or assembly, or as an intermittent failure, which can be difficult and costly to locate.

ESD Procedures and Precautions

Follow these procedures and precautions to prevent ESD damage to the ESD-sensitive microelectronic components and assemblies in the Power Pack.

- Use a personnel grounding system. Before opening the Power Pack housing, ensure a personnel grounding system such 4-018049-00 (wrist strap, static-dissipative mat, and ground cord) or equivalent is worn correctly and is properly connected to a reliable ground.
- Follow correct procedures when using an anti-static mat. Place tools, test equipment, and the ESD-sensitive device on the mat before starting repairs. Conduct all work on the mat.
- Handle ESD-sensitive components properly. Do not handle ESD-sensitive component connection points, connector pins, leads, or terminals.
- Keep nonconducting materials away from the work area. Static charges from nonconducting material, (e.g., plastic containers, foam cups, synthetic clothing, cellophane tape, etc.) cannot be removed by grounding. These items must be kept away from the work area when handling ESD-sensitive devices.
- Follow correct procedures for use of static-shielding bags. Store and transport all ESD-sensitive devices in static-shielding bags at all times, except when being worked on. Never place more than one ESD-sensitive device in a static-shielding bag. Never place static generating, nonconducting material inside a static-shielding bag with an ESD-sensitive device. Place any faulty ESD-sensitive devices in a static-shielding bag immediately after removal to prevent additional damage. Close the bag to ensure the shield is effective.

8.3 Tools and Equipment

Table 8-1 lists the tools and equipment needed to service the Power Pack.

Note: Part numbers are subject to change.

Table 8-1. Tools and Equipment For Servicing the Power Pack

Tool	Manufacturer/Model/ Covidien Part Number	Where Used
Static-dissipative field service kit (includes wrist strap, static dissipative mat, and ground cord)	4-018149-00 or equivalent	General servicing
Standard tool kit including: Hexalobular (Torx®) drivers sizes T8, T9, T10, T20; #1 Phillips screwdriver; Needle nose pliers; Small flat bladed screwdriver; Tie wraps; Tie-wrap applicator gun; Cable cutter	Local supplier	Service and repair
Electrical safety analyzer	Fluke ESA 620 or equivalent analyzer capable of performing electrical safety tests for Class II, Type BF equipment	Electrical Safety Test
Electrical Safety Test Ground Cable	10131171	Electrical Safety Test

8.4 Internal Battery Replacement

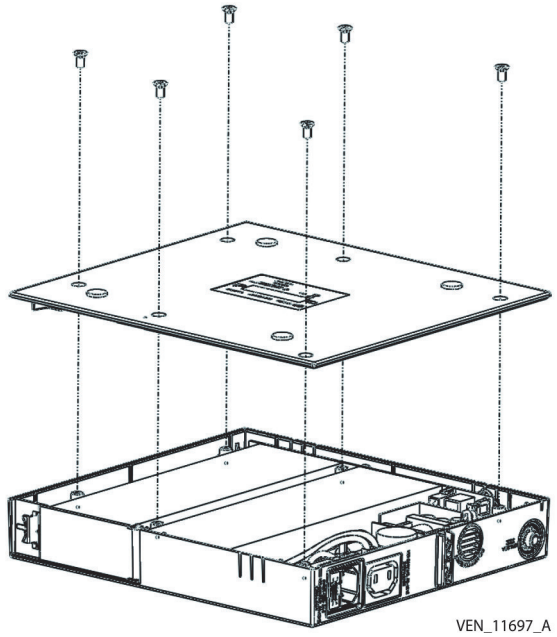
Warnings

- **Ensure AC power is disconnected when removing or installing the battery.**
- **Do not open the battery for any reason.**
- **Use care to apply proper pressure on the housing cover when installing screws.**
- **To prevent possible damage to the power supply, remove the removable battery from Power Pack during disassembly and reassembly.**
- **To prevent possible damage following removal, cover battery terminals in nonconductive packaging to avoid shorting and to store the battery so that it cannot be damaged.**
- **Replacement batteries must be inserted as instructed. Incorrect orientation may cause damage to the battery and/or Printed Circuit Board Assembly (PCBA).**

To remove the internal battery:

1. Remove the six screws from the housing cover using a T20 Torx® driver.
2. Remove the cover from the housing.
3. Remove the internal battery from the housing.

Figure 8-1. Enclosure Screw Removal



To replace the battery:

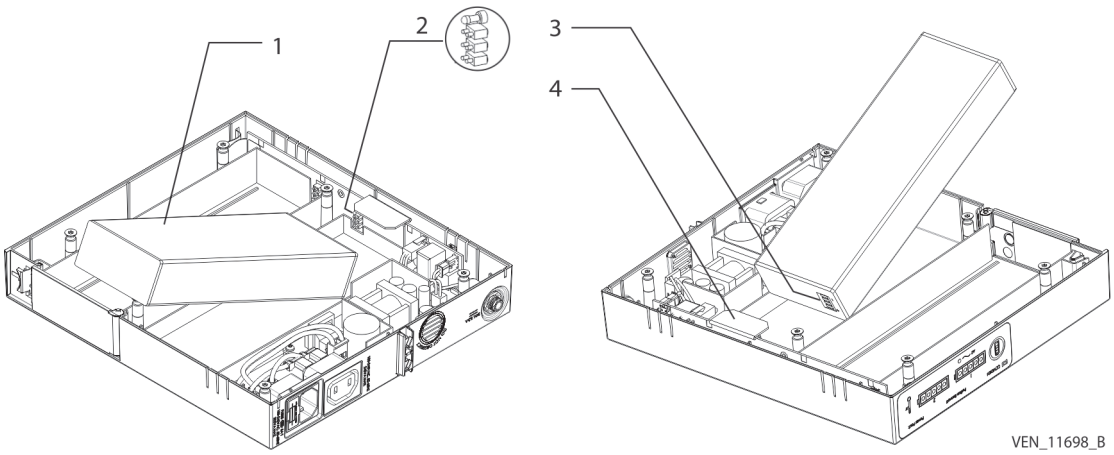
1. Install the internal battery so that the terminals will make contact with the battery connector terminals when installed into the housing.

   Figure 8-2 shows the correct orientation of the battery.
2. While holding the main Printed Circuit Board Assembly (PCBA) in place, slide the internal battery into the housing at an angle with the battery oriented so that the battery terminals make contact with the terminals on the PCBA.

3. Before replacing the housing cover, verify that the main PCBA is correctly located in the lower housing slot and that the hinge pin of the removable battery compartment door fits into its retaining slot in the lower housing.
4. Replace the cover on the housing, ensuring that the main PCBA fits into the slot in the cover and that the hinge pin of the removable battery compartment door fits into its retaining slot in the cover. Use a T20 Torx® driver to install the six screws in the housing cover. Do not over-tighten.

Note: Dispose of used batteries according to your local governing ordinances and recycling regulations.

Figure 8-2. Internal Battery Orientation



1 Internal battery
2 PCBA contacts
3 Battery terminals
4 Battery contact guard

To verify operation of the replacement battery:

1. Perform the electrical safety test. See "Electrical Safety Test" on page 42.
2. Connect the Power Pack to the AC mains supply.
3. Verify that the green AC Mains LED lights up to indicate that mains power is turned on.
4. Verify that the ten Battery Charge level LEDs and the red temperature indicator LED light up for 0.5 seconds to indicate that Power Pack has powered up.
5. Following the power-up sequence, verify that one of the following occurs:
   - The five Battery Charge LEDs for the internal battery (Battery 1) light up in sequence to indicate that the replacement internal battery is charging.
   - The five Battery Charge LEDs for the internal battery (Battery 1) light up and remain lit to indicate that the replacement internal battery is fully charged.

8.5 AC/DC Converter and Battery Charger Replacement

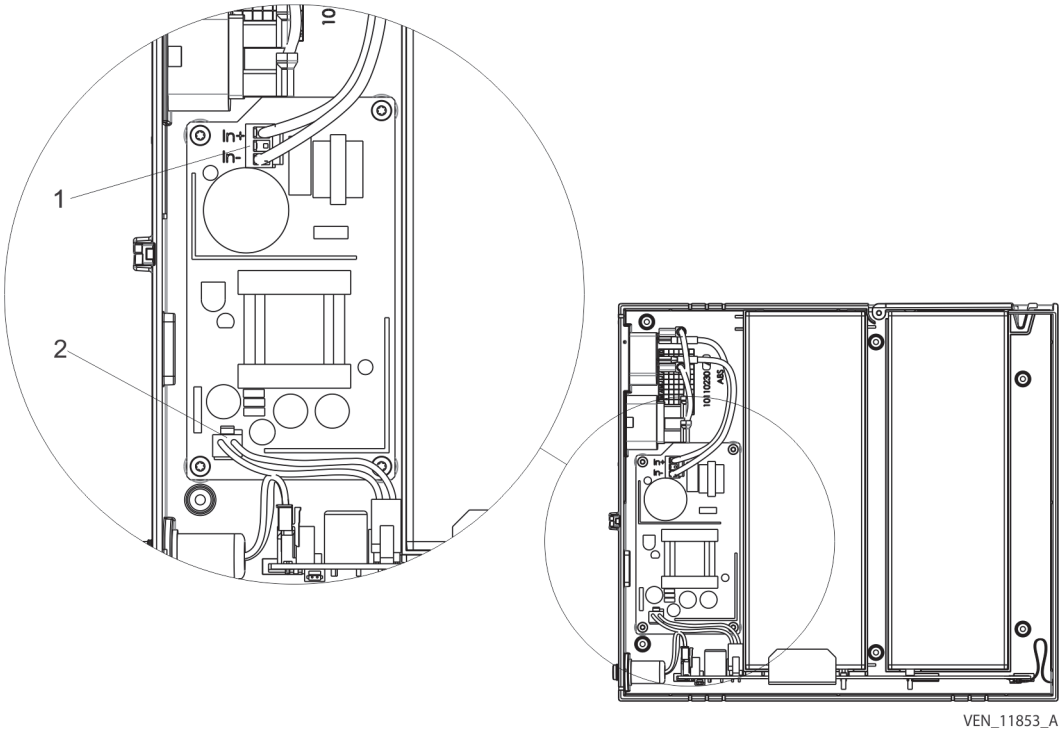
Warnings

- **Ensure AC power is disconnected when removing or replacing the AC/DC converter and battery charger.**
- **Ensure the internal and removable batteries are removed before removing or replacing the AC/DC converter and battery charger.**

To remove the AC/DC converter and battery charger:

1. Remove the housing cover as described in section 8.4, "Internal Battery Replacement".
2. Disconnect the battery charger input cable (blue and brown) from connector K01.
3. Disconnect the battery charger output cable (black and red) from connector K02.

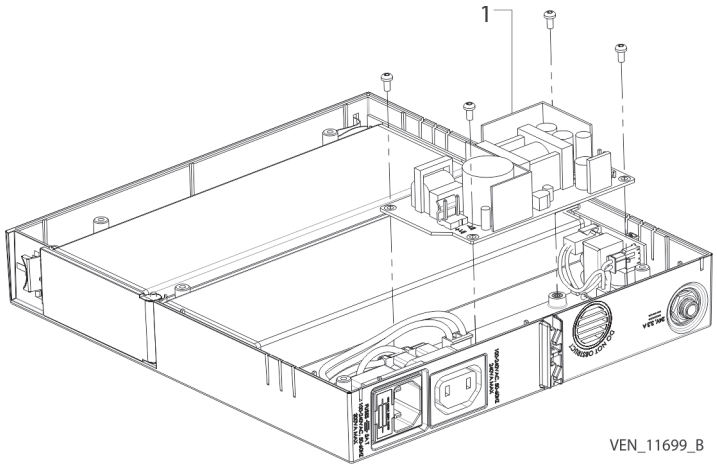
Figure 8-3. Input and Output Cable Connectors



1 Connector K01
2 Connector K02

4. Loosen the four screws holding the battery charger in place. Remove the screws and charger and set to one side. Observe ESD precautions while the charger is removed from the housing.

Figure 8-4. AC/DC Converter and Battery Charger Screws



To insert the replacement AC/DC converter and battery charger:

1. Replace the unit in the housing with the four mounting holes lined up with the retainers in the housing.
2. Replace the four screws holding the unit in place.
3. Reconnect the battery charger input cable (blue and brown) to connector K01, ensuring that the cable and charger PCB connectors are oriented correctly.
4. Reconnect the charger output cable (black and red) to connector K02, ensuring that the cable and charger PCB connectors are oriented correctly.
5. Replace the internal battery and housing cover as described in section 8.4, "Internal Battery Replacement".

To verify operation of the replacement AC/DC converter and battery charger:

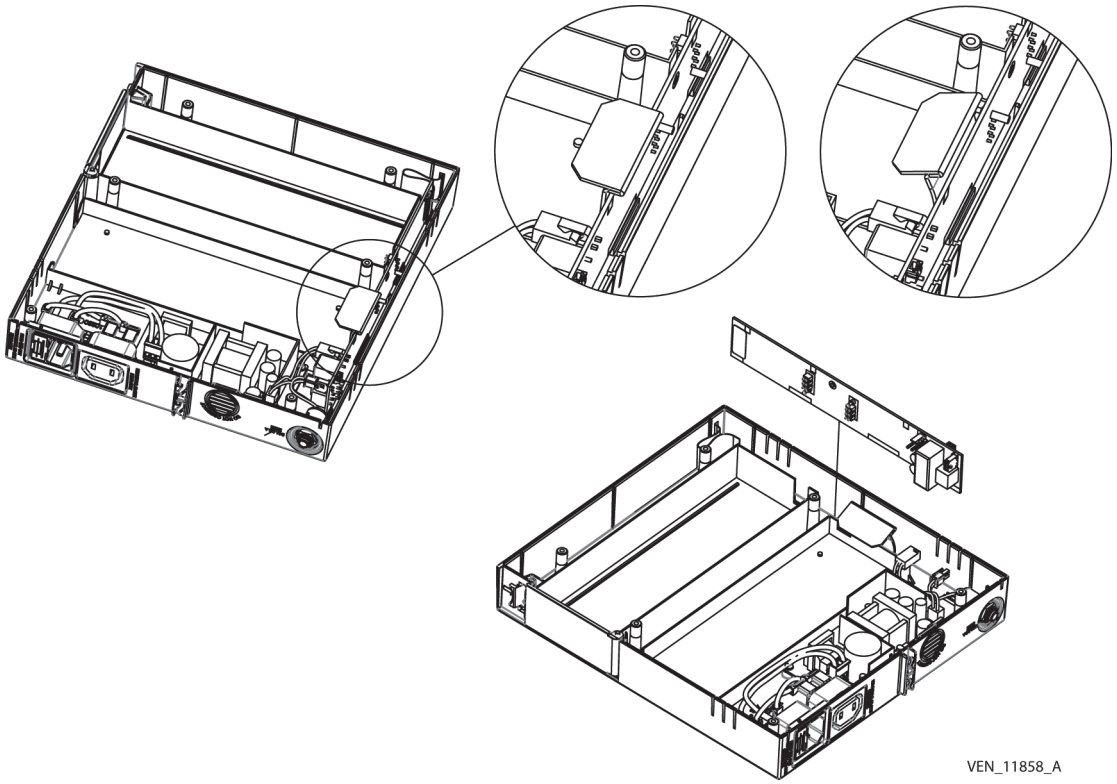
1. Perform the electrical safety test. See "Electrical Safety Test" on page 42.
2. Connect the Power Pack to the AC mains supply.
3. Verify that the green AC Mains LED lights up to indicate that mains power is turned on.
4. Verify that the ten Battery Charge indicator LEDs and the red temperature indicator LED light up for 0.5 seconds to indicate that Power Pack has powered up.
5. Verify that the battery charger is operational by monitoring the Battery Charge indicator LEDs to ensure the installed batteries are being charged as described in section 4.4, "Charging the Power Pack Batteries".

8.6 Printed Circuit Board Assembly Replacement

Warnings

- **Disconnect AC power when removing or replacing the Printed Circuit Board Assembly (PCBA).**
- **Remove the internal and removable batteries before removing or replacing the PCBA.**
- **To avoid damage to the PCBA, follow all ESD precautions. Hold the PCBA only at the edges to avoid damage to any components.**

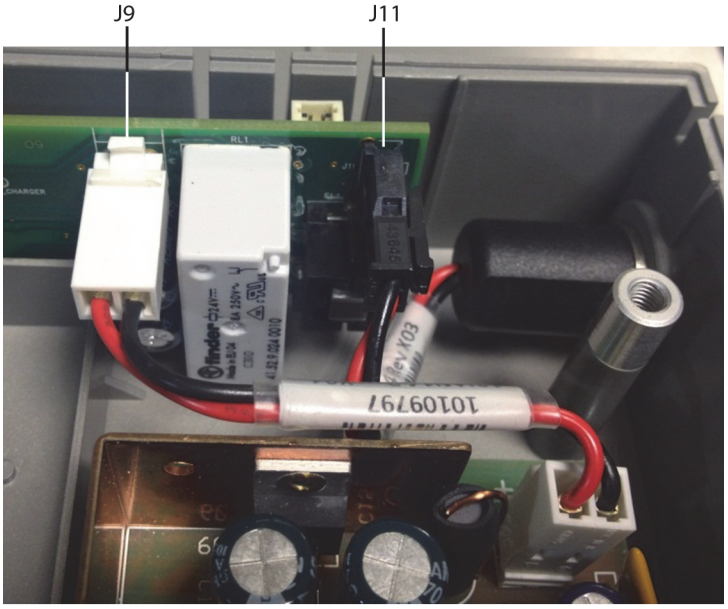
Figure 8-5. PCBA Removal



To remove the PCBA:

1. Remove the housing cover as described in section 8.4, "Internal Battery Replacement".
2. Disconnect the PCBA to DC output cable harness from connector J11 on the PCBA.
3. Disconnect the battery charger to PCBA harness from connector J9 on the PCBA.

Figure 8-6. Input and Output Cable Disconnection

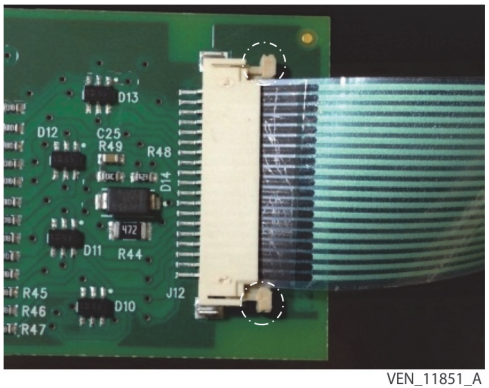


4. Lift the PCBA out of the housing to allow disconnection of the keypad flex cable from connector J12 on the PCBA.

Note:
The protective battery contact guard must be held out of the way to allow the PCBA to be lifted out.

5. Open the J12 connector latch mechanism on the PCBA and disconnect the keypad flex cable as shown in Figure 8-7.

Figure 8-7. J12 Connector Open

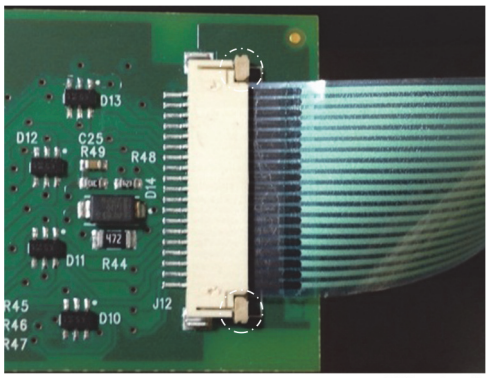


To replace the PCBA:

1. Remove the Power Pack PCBA from the ESD packaging.
2. Check that the plastic PCBA standoff is mounted on the PCBA as in the unit being replaced.
3. Ensure the J12 connector latch mechanism on the PCBA is open and reconnect the keypad flex cable as shown in Figure 8-7.

4. Ensure flex tail is fully pushed into connector before closing the latch. Secure the latch and ensure both sides are closed as shown in Figure 8-8.

Figure 8-8. J12 Connector Closed



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5. Reconnect the PCBA to DC output cable harness to J11 on the top side of the PCBA.
6. Slot the PCBA board into location, ensuring that it slots into the housing cut-out sections for battery connections and is seated correctly under the battery contact guard. Ensure there are no kinks in the cables, the flex cable is looped, and the board is seated correctly in the housing slot.
7. Reconnect the battery charger to PCBA cable harness to PCBA connector J9.
8. Replace the internal battery and the housing cover as described in section 8.4, "Internal Battery Replacement".

To verify operation of the replacement PCBA:

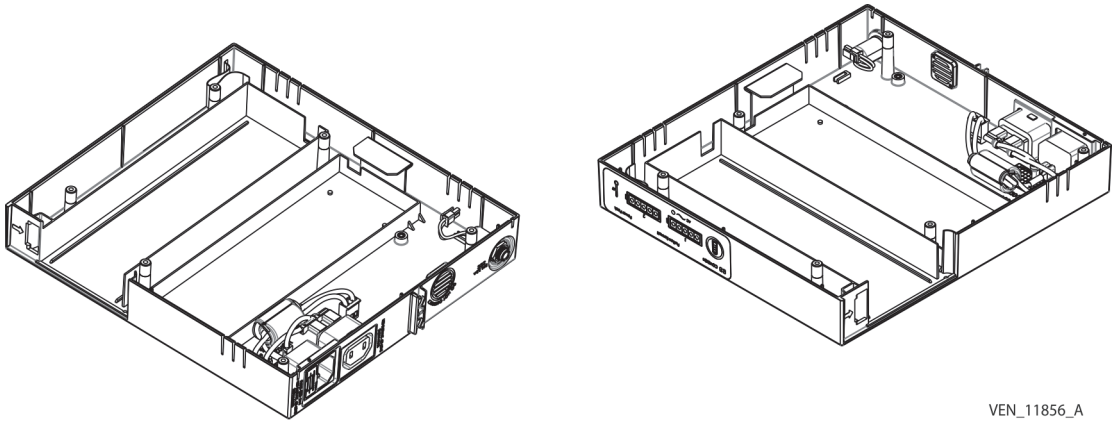
1. Perform the electrical safety test. See "Electrical Safety Test" on page 42.
2. Connect the Power Pack to the AC mains supply.
3. Verify that the green AC Mains LED lights up to indicate that mains power is turned on.
4. Verify that the 10 Battery Charge indicator LEDs and the red temperature indicator LED light up for 0.5 seconds to indicate that the Power Pack has powered up.
5. Verify that the PCBA is operational by monitoring the Battery Charge indicator LEDs to ensure the installed batteries are being charged as described in section 4.4, "Charging the Power Pack Batteries".

8.7 Main Housing Assembly Replacement

Warnings

- **Disconnect AC power when removing or replacing the Printed Circuit Board Assembly (PCBA).**
- **Remove the internal and removable batteries before removing or replacing the PCBA.**
- **To avoid damage to the PCBA, follow all ESD precautions. Hold the PCBA only at the edges to avoid damage to any components.**

Figure 8-9. Main Assembly



VEN_11856_A

To replace the main housing assembly:

1. Remove the housing cover and internal battery from the old Power Pack unit as described in section 8.4, "Internal Battery Replacement".
2. Remove the AC/DC converter and battery charger from the old Power Pack unit as described in section 8.5, "AC/DC Converter and Battery Charger Replacement".
3. Remove the Printed Circuit Board Assembly (PCBA) from the old Power Pack unit as described in section 8.6, "Printed Circuit Board Assembly Replacement".
4. Remove the removable battery compartment door from the old Power Pack unit by lifting it from the main housing.
5. Install the battery charger in the new main housing assembly by following the instructions for installing the battery charger in section 8.5, "AC/DC Converter and Battery Charger Replacement".
6. Install the Printed Circuit Board Assembly (PCBA) by following the instructions for installing the PCBA in section 8.6, "Printed Circuit Board Assembly Replacement".
7. Install the removable battery compartment door by inserting the hinge pin in the retaining slot of the lower housing.
8. Ensure that all cables are connected internally in the unit as follows:
   - Battery charger input cable connected to battery charger input connector K01
   - Battery charger output cable connected from battery charger connector K02 to PCBA connector J9
   - PCBA to DC output cable harness connected to PCBA connector J11
   - Keypad flex connector connected to PCBA connector J12

9. Replace the internal battery and housing cover as described in section 8.4, "Internal Battery Replacement".

To verify operation of the replacement main housing assembly:

1. Perform the electrical safety test. See "Electrical Safety Test" on page 42.
2. Connect the Power Pack to the AC mains supply.
3. Verify that the green AC Mains LED lights up to indicate that mains power is turned on.
4. Verify that the 10 Battery Charge indicator LEDs and the red temperature indicator LED light up for 0.5 seconds to indicate that the Power Pack has powered up.
5. Verify that the PCBA is operational by monitoring the Battery Charge indicator LEDs to ensure the installed batteries are being charged as described in section 4.4, "Charging the Power Pack Batteries".

8.8 Housing Cover and Battery Compartment Door Replacement

⚠ Warnings

- **Disconnect AC power when removing or replacing the Printed Circuit Board Assembly (PCBA).**
- **Remove the internal and removable batteries before removing or replacing the PCBA.**
- **To avoid damage to the PCBA, follow all ESD precautions. Hold the PCBA only at the edges to avoid damage to any components.**

To replace the housing cover and door:

1. Remove the six screws from the housing cover using a T20 Torx® driver as described in section 8.4, "Internal Battery Replacement".
2. Remove the cover from the housing.
3. Remove the identification label from the old housing cover and affix to the replacement unit. Ensure that the label is clearly legible, including the Power Pack serial number. If the old label is damaged or illegible, replace with a new one, which is supplied but not attached to the housing door, FRU part number 10132668. This label has a window to which the serial number of the old unit can be affixed.
4. If also replacing the removable battery compartment door, lift it from the main housing.
5. If necessary, install the replacement removable battery compartment door by inserting the hinge pin in the retaining slot of the lower housing.
6. Replace the cover on the housing, ensuring that the main PCBA fits into the slot in the cover and that the hinge pin of the removable battery compartment door fits into its retaining slot in the cover.
7. Use a T20 Torx® driver to install the six screws in the housing cover. Do not over-tighten.

To verify operation following replacement of the cover or battery compartment door:

1. Perform the electrical safety test. See "Electrical Safety Test" on page 42.
2. Connect the Power Pack to the AC mains supply.
3. Verify that the green AC Mains LED lights up to indicate that mains power is turned on.

4. Verify that the 10 Battery Charge indicator LEDs and the red temperature indicator LED light up for 0.5 seconds to indicate that the Power Pack has powered up.
5. Verify that the PCBA is operational by monitoring the Battery Charge indicator LEDs to ensure the installed batteries are being charged as described in section 4.4, "Charging the Power Pack Batteries".

8.9 Electrical Safety Test

This test verifies that the Puritan Bennett Power Pack meets the leakage current requirements of IEC 60601-1:2005 for Class II, Type BF devices. You may use any electrical safety analyzer capable of performing the required tests for this device classification. Refer to Table 8-2 for appropriate test limits. Refer to the analyzer operating instructions for details on test setup and test steps.

Required equipment:

See section 8.3, "Tools and Equipment" for part numbers.

- Electrical safety analyzer
- Electrical safety test ground cable

⚠ Warnings

- **Never perform any of the tests described in this chapter while the Power Pack unit is connected to the mains or to a ventilator.**
- **This test requires working with exposed electronics connected to AC power. To prevent personal injury and damage to the unit, use extreme caution to keep hands and tools from touching electrical components.**

To perform the electrical safety test:

1. Test the Power Pack unit according to the electrical safety analyzer's instructions.
2. Verify the test results are within the limits listed in Table 8-2.

Table 8-2. Electrical Safety Test Limits

Test	Line Configuration	Test Limit
Enclosure Leakage Current	Normal Condition (NC)	100 µA
Enclosure Leakage Current	Normal Condition/Reversed Mains (NCRM)	100 µA
Enclosure Leakage Current	Open Supply (OS)	500 µA
Enclosure Leakage Current	Open Supply/Reversed Mains (OSRM)	500 µA

8.10 PB500 Series Battery Extraction Tab Installation

A Battery Extraction Tab kit (part number 10100901) has been released for use with the Puritan Bennett™ Power Pack battery. The tab can be used to partially extract the battery from the Power Pack enclosure. Installation of the tab is optional and is not a mandatory update to the Power Pack battery.

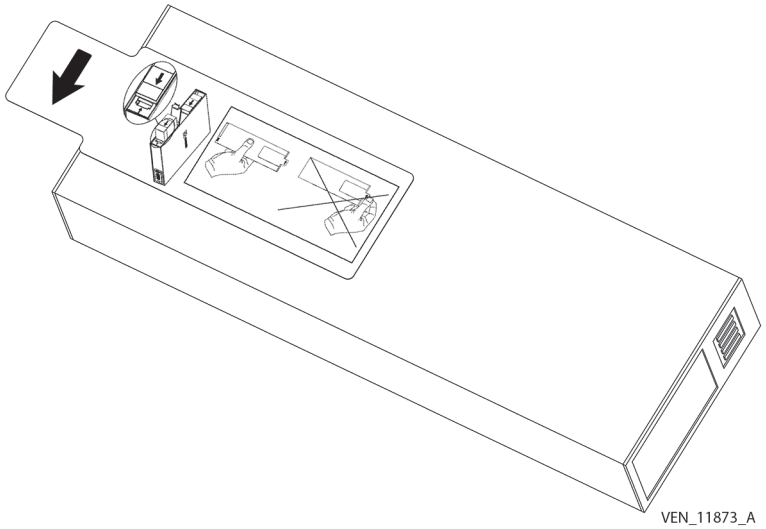
Caution

The extraction tab must not be used as the sole method of supporting or retaining the battery.

To install the extraction tab:

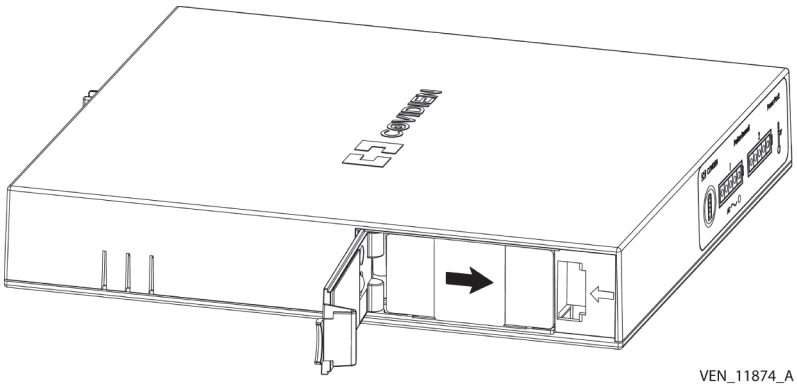
1. Identify the correct location on the Power Pack battery where the tab is to be attached (see Figure 8-10).
2. Using a cotton towel, wipe, or equivalent, moistened with an alcohol-based cleaning solution, clean the surface where the label portion of the tab will be applied.
3. After the surface has dried, remove the label backing and secure the label to battery according to the instructions on the label.
4. Rub the label with a soft cloth to remove any bubbles that may be trapped under the label.
5. Fold the tab flush with the end of the battery.

Figure 8-10. Battery with Extraction Tab Attached



When the label has been attached correctly, the arrow on the tab aligns with the arrow in the Power Pack enclosure to indicate that the battery has been inserted correctly, as shown in Figure 8-11.

Figure 8-11. Battery Orientation Indicator



9 Product Specifications

9.1 Overview

This chapter contains physical and operational specifications. Ensure all product requirements for both the Puritan Bennett™ Power Pack and the Puritan Bennett™ 500 Series Ventilator are met prior to operating the Power Pack with the ventilator.

9.2 Power Pack Electrical Characteristics

Table 9-1. Power Pack Electrical Characteristics

Characteristic	Extra Long Life Power Pack Battery
AC Input Voltage	100 VAC to 240 VAC nominal
AC Frequency	50 Hz / 60 Hz
Consumption	300 VA max
DC Voltage Output	25.2 VDC (nominal)
Full-load capacity	4.8 Ah
Watt hour rating	124Wh to 126Wh
Battery recharge time	Fully recharge: <6 hours
Charging current	1.2A

9.3 Average Battery Operating Times

A fully charged battery provides ventilator power for the following average durations based on ventilator settings, environmental conditions, and physiological characteristics of the patient.

Table 9-2. Average Times, Based on Ventilator Settings and Battery Type

Usage	Duration with 1 Battery (% indicates tolerance)	Duration with 2 Batteries (% indicates tolerance)
Vt = 200 ml (± 5 ml), PIP = 10 mbar (± 2 mbar), Rtot = 20 bpm	9 hr. (–10%)	18 hr. (–10%)
Vt = 300 ml (± 5 ml), PIP = 20 mbar (± 2 mbar), Rtot = 15 bpm	8 hr. (–10%)	16 hr. (–10%)
Vt = 500 ml (± 5 ml), PIP = 30 mbar (± 2 mbar), Rtot = 15 bpm	6 hr. (–10%)	12 hr. (–10%)
Vt = 750 ml (± 5 ml), PIP = 45 mbar (± 2 mbar), Rtot = 20 bpm	4 hr. (–10%)	8 hr. (–10%)

9.4 Environmental Conditions

Operating

Ambient Temperature Range	+5°C to +40°C (41°F to 104°F)[a]
Atmospheric Pressure	600 hPa to 1100 hPa
Relative Humidity	10% to 95%, non condensing

a. If stored outside the ambient temperature range, but within the storage range, the Power Pack should be fully functional 2 hours after placement in +23°C environment

Transport and Storage

Temperature	-40°C to +70°C (-40°F to 158°F)[a]
Atmospheric Pressure	500 hPa to 1060 hPa
Relative Humidity	10% to 95%, non condensing

a. If stored outside the ambient temperature range, but within the storage range, the Power Pack should be fully functional 2 hours after placement in +23°C environment

Under extreme conditions of use that are beyond the recommendations above but within the limits of a supply voltage of –20%, compared to the nominal temperature or the combination of a temperature of 45 °C (113 °F) and humidity of 75% RH, the device should not malfunction nor endanger the user. However, operating the device for prolonged periods or repeatedly under such extreme conditions could result in premature aging of components and more frequent maintenance.

9.5 Product Compliance

Equipment Classification	IEC/EN 60601-1 3rd Edition
Protection Against Electric Shock	Class II or internally powered
Mode of Operation	Continuous
Liquid and Particulate Ingress	IP32 (Inside carrying bag)
Applied Part Classification	No applied parts are provided
Suitability for Use with Flammable Anaesthetics	Not suitable for use with flammable anaesthetics
Method of Sterilization	Not suitable for sterilization

9.6 Manufacturer's Declaration

The following tables contain the manufacturer's declarations for the ventilator and Power Pack electromagnetic emissions, electromagnetic immunity, and recommended separation distances between the ventilator with Power Pack and portable and mobile RF communications equipment, as well as a list of compliant cables.

Warning

Portable and mobile RF communications equipment can affect the performance of the ventilator and Power Pack. Install and use this device according to the information contained in this manual.

The ventilator and Power Pack should not be used adjacent to or stacked with other equipment, except as specified in this manual. If adjacent or stacked use is necessary, the ventilator should be observed to verify normal operation in the configurations in which it will be used.

In 9-3 to 9-5, the Puritan Bennett™ 500 Series Ventilator and Puritan Bennett™ Power Pack are intended for use in the electromagnetic environment specified below. The customer or the user of the ventilator and Power Pack should ensure it is used in such an environment.

Table 9-3. Electromagnetic Emissions

RF emissions CISPR 11 / EN 55011	Group 1	The battery uses RF energy only for its internal functions. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11 / EN 55011	Class B	The battery is suitable for use in all establishments including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC / EN 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC / EN 61000-3-3	Complies	

Table 9-4. Electromagnetic Immunity

Immunity Test	IEC / EN 60601 Test Level	Compliance Level	Electromagnetic Environment–Guidance
Electrostatic discharge (ESD) IEC / EN 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC / EN 61000-4-4	± 2 kV for power supply lines	± 2 kV for power supply lines	AC power ("mains") quality should be that of a typical commercial or hospital environment.
Surge IEC / EN 61000-4-5	± 1 kV lines/lines ± 2 kV lines/earth	± 1 kV lines/lines ± 2 kV lines/earth	AC power ("mains") quality should be that of a typical commercial or hospital environment.

Table 9-4. Electromagnetic Immunity (Continued)

Voltage dips, short interruptions and voltage variations on power supply input lines IEC / EN 61000-4-11	< 5% U_T (> 95% dip in U_T for 0.5 cycle) 40% U_T (60% dip in U_T for 5 cycles) 70% U_T (30% dip in U_T for 25 cycles) < 5% U_T (> 95% dip in U_T for 5 s)	< 5% U_T (> 95% dip in U_T for 0.5 cycle) 40% U_T (60% dip in U_T for 5 cycles) 70% U_T (30% dip in U_T for 25 cycles) < 5% U_T (> 95% dip in U_T for 5 s)	AC power ("mains") power quality should be that of a typical commercial or hospital environment. **Note: U_T is the AC mains voltage prior to application of the test level.**
Power frequency (50/60 Hz) magnetic field IEC/ EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a location typical in a commercial or hospital environment.

Table 9-5. Electromagnetic Immunity – Conducted and Radiated RF

Immunity Test	IEC / EN 60601-1-2 Test Level	Compliance Level	Electromagnetic Environment–Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the battery, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Recommended separation distance			
Conducted RF IEC / EN 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands[a]	3 Vrms 150 kHz to 80 MHz outside ISM bands	d =0.35√P
	10 Vrms inside ISM bands[a]	10 Vrms inside ISM bands	d=1.2√P
	10 V/m 80 MHz to 2.5 GHz	10 V/m 80 MHz to 2.5 GHz	d=1.2√P80 MHz to 800 MHz
Radiated RF IEC / EN 61000-4-3			d =2.3√P 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m)[b]. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[c], should be less than the compliance level in each frequency range[d]. Interference may occur in the vicinity of equipment marked with the following symbol:

Table 9-5. Electromagnetic Immunity – Conducted and Radiated RF (Continued)

Note:

At 80 MHz and 800 MHz, the higher frequency range applies.

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

[a] The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz'; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

[b] The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

[c] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the ventilator and Power Pack is used exceeds the applicable RF compliance level above, the ventilator and Power Pack should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the ventilator and Power Pack.

[d] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 10 V/m.

Table 9-6. Recommended Separation Distances

The ventilator and Power Pack are intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the ventilator and Power Pack can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the ventilator and Power Pack as recommended below, according to the maximum output power of the communications equipment.

Rated Maximum Output Power of Transmitter (W)	**Separation Distance According to Frequency of Transmitter**			
	150 kHz to 80 MHz (outside ISM bands) d=0.35 √P	**150 kHz to 80 MHz** (in ISM bands) d= 1.2 √P	**80 MHz to 800 MHz** d = 1.2 √P	**800 MHz to 2.5 GHz** d = 2.3 √P
0.01	0.035 m	0.12 m	0.12 m	0.23 m
0.1	0.11 m	0.38 m	0.38 m	0.73 m
1	.35 m	1.2 m	1.2 m	2.3 m
10	1.1 m	3.8 m	3.8 m	7.3 m
100	3.5 m	12 m	12 m	23 m

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note:

At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz.

An additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

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